SYNOPSIS OF THE PROPOSED STUDY

ON

E-WASTE MANAGEMENT IN INDIA

(A RECYCLERS PERSPECTIVE)

Supervisor:

Dr. Santosh Dhar

Professor Incharge- Doctoral Studies and Research

JK Lakshmipat University

Jaipur

Research Scholar:

Namrata Jain

JK Lakshmipat University

Jaipur

INTRODUCTION

Technological advancements provide an impetus for growth and development of any country. However, along with growth and development they have also given rise to some serious environmental and social issues. Technology has made our life simpler, easier and comfortable but at the same time it has also created certain challenges before us. Electronic industry is a setting example of this. Along with increased production and proliferation of electronic goods, such as computers, televisions, mobile phones etc., their rates of disposal have also increased substantially. Due to advancements in technology, people are frequently changing electronic devices. The devices are also discarded because arrival of new technologies results in quick obsolescence. Consequently, a large number of electronic devices are getting rejected even when they are in working condition or are repairable. These discarded electronic devices constitute the electronic waste (e-waste). However, due to lack of awareness and in the absence of proper arrangement of disposal or recycling, such e-waste is often treated as a regular waste.

According to the guidelines for environmentally sound management of e-waste (2008), the waste produced from used electronic devices and home appliances which have become unfit for their original purpose and are now meant for recovery, recycling or disposal are known as electronic waste. E-waste has also been defined as the waste electrical or electronic equipment (WEEE), whole or in part, or rejects from manufacturing and repairing processes that are intended to be discarded (Ministry of Environment and Forests, 2010). Kurian (2007) described e-waste as those obsolete electronic devices that are no longer used by their owners due to technological growth and product obsolescence. Thus, e-waste is the waste generated from useless or discarded electrical or electronic equipments which are unsuitable for their original purpose. According to Pinto (2008), discarded, old or end-of-life devices like computers, laptops, TVs, DVD players, mobile phones, mp3 players, etc. constitute e-waste. Nnorom and Osibanjo (2010) stated that e-waste is the result of enormous production of consumer electrical and electronic equipment with brief time scales in technology and stylistic obsolescence.

E-waste is mainly classified into three categories, namely large household appliances, IT and telecom equipments, and consumer equipments (Guidelines for environmentally sound management of e-waste, 2008). E-waste Management and Handling Rules (2011) have

categorized electrical and electronic equipments as IT and telecom equipments, and consumer electrical and electronic equipments. IT and telecom equipments include devices like computers, copiers, telephones, cellular phones, answering machines and typewriters while consumer electrical and electronic equipments include devices like televisions, refrigerators, washing machines and air conditioners.

E-waste contains variety of different substances falling under hazardous and non-hazardous categories. It mainly consists of ferrous and non-ferrous metals, plastics, glass, wood, plywood, printed circuit boards, ceramics, rubber and other items. Iron and steel constitutes about 50 percent of the e-waste followed by plastics 21 percent, non ferrous metals 13 percent and other constituents. Metals found in e-waste include copper, aluminum, silver, gold, platinum, palladium etc. The presence of elements like lead, mercury, arsenic, cadmium, selenium, hexavalent chromium and flame retardants beyond threshold quantities in e-waste classifies it as hazardous waste.

REVIEW OF LITERATURE

The growth of e-waste has significant economic and social impacts. It is becoming one of the fastest growing waste streams in the world. It is increasing at an alarming proportion not only in the developed nations but also in the developing countries. The world wide generation of e-waste is estimated to be more than 50 million metric tonne per year as per a report *E-waste in India* (2011). Leading generators of e-waste include countries like US and China. US produces about 3 million metric tonnes of e-waste per year whereas China generates about 2.3 million metric tonnes. It has also been estimated that e-waste is increasing approximately three times faster than municipal waste stream in European Union (Schwarzer et al, 2005). It is also projected that by 2030, developing countries will discard around 400-700 million computers annually in comparison to 200-300 million by developed countries (Thilmany, 2010). It was also estimated that by 2020, e-waste generation by developing countries will be twice that of by the developed countries. During the same period, the amount of e-waste generated due to discarded mobile phones would grow by 7 times in China and 18 times in India, in comparison to the extent of same in 2007.

E-waste inventory in India for the year 2005 was estimated to be 1.46 lac metric tonne which was projected to increase to 8 lac metric tonne by 2012. Moreover, it is also estimated that personal computer waste contributes to more than 60 percent in total quantity of e-waste generated. The top ten states that generate over 70 percent of total e-waste in India include Maharashtra, Tamilnadu, Andhra Pradesh, Uttar Pradesh, West Bengal, Delhi, Karnataka, Gujarat, M.P. and Punjab. The leading e-waste generating cities in India are Mumbai, Delhi, Bangalore, Chennai, Kolkatta, Ahemdabad, Hyderabad, Pune, Surat and Nagpur.

The increased production of electrical and electronic products, higher consumption and obsolescence rate lead to higher generation of e-waste. The increasing market penetration in developing countries and replacement market in developed countries is also one of the reasons for the speedy growth of e-waste. Moreover, Wolfington and Maranto (2008) stated that apart from domestic generation, illegal imports also increases the quantity of e-waste generated in developing countries. India is importing about 50 thousand metric tonne of e-waste per year (Khattar et al, 2007).

E-waste not only contains heavy metals but is also a source of many valuable items like silver, gold, palladium, copper and iron. It is the presence of these and other valuable items that workers involve themselves in unscientific and traditional methods of extraction. Open burning, acid dumping, exposure to toxic solders and dismantling are some of the common practices used by the workers for extraction. These methods are neither efficient nor safe. In addition, after extraction of valuables, the acid, alkali or other chemicals, soiled water and even the left scrap of e-waste is carelessly dumped at the site itself thereby creating a danger for current as well as for future generations. There are thousands of workers including men, women and children engaged in the hazardous occupation of informal recycling. These workers have risked their life as the job serves them as a means of livelihood.

Besides this, the hazards associated with informal recycling of e-waste are not confined to the recycling site itself. The ill effects extend beyond the site boundaries and pollute the environment. The damages caused to the health of people living in nearby areas, are very far reaching and may even affect the unborn. Chen et al (2011) found that that there was a risk of

perturbations of fetus and child neuro-development to pregnant women living in the vicinity of informal e-waste recycling site. Increased level of pollutants in body fluid has been found in workers working at major e-waste recycling towns of China. The sample of water taken from river close to one of the recycling village in China revealed that the level of lead in it is about 2400 times higher in comparison to drinking water guidelines set up by World Health Organization. Higher concentrations of heavy metals like cadmium, copper is found at e-waste recycling sites (Amfo-Out et al, 2013) and even in dust sample taken from nearby school compound (Ateimo, 2012) in Ghana. Improper management or handling of e-waste gives birth to serious health problems because of toxic and heavy metals found in them (Saoji, 2012).

India is no different when it comes to health and environmental threats due to inadequate management of e-waste. There are large number of informal e-waste recycling sites near Delhi, Meerut, Firozabad, Chennai, Bangalore and Mumbai. These sites may also contain high level of hazardous chemicals. For instance, a study undertaken by Greenpeace in 2005 observed deadly dioxins and furans at the recycling site of Delhi (http://www.greenpeace.org/india/Global/india/report/2005/8/recycling-of-electronic-wastes.pdf, accessed on august 25, 2011). The informal sector operating through such sites are dominating the formal ones. They are managing to receive greater quantity of e-waste in comparison to formal ones. This makes them to process about 95 percent of e-waste out of the total e-waste accessible for recycling in India (http://deity.gov.in/sites/upload_files/dit/files/EWaste_Sep11_892011.pdf, accessed on February, 2013). It has been reasoned by Raghupathy et al (http://www.iswa.org/fileadmin/galleries/General%20Assembly%20and%20WC%202010%2011%20Hamburg/Presentations/Krueger.pdf, accessed on February, 2013) that door to door collection and the satisfactory cash incentive offered by informal sector to consumers made them to get more e-waste. It implies the need of integrating informal sector with formal. It would help later in obtaining sufficient quantity of e-waste to formal recyclers for scientific processing. However, it has been asserted by Raghupathy that it is not easy to formalize them. There are multiple stakeholders involved in the intermediate stages. There is lack of accurate information about their widespread networks and the way entire financial mechanism flows among them.

Scientific recycling of e-waste would help in conserving natural resources, energy and time. It offers an employment opportunity for many workers. It would help in promoting sustainability. It would also help in reducing cost. For instance, Giutini and Gaudette (2003) said that the remanufactured product provides up to 30-40 percent of saving in cost. The other benefits of recycling include the presence of precious metals in e-waste as such in greater amount. For example, (Delfini et al, 2011) reported that e-waste contains 50-60 times greater content of precious metal in comparison to normally mined ore. Moreover, according to author, it will cover the entire cost of its processing because in well equipped modern recycling plant, about 80 percent of material can be recovered, 15 percent can be used for burning and remaining 5 percent only ends as waste. But Wath et al (2011) stated that in India technologies adopted for e-waste recycling or treatment are not environment friendly. Most of the operations are done manually without caring for proper personnel protection equipment.

Ogunseitan et al (2009) said that the matter of e-waste has leaked out as a serious worldwide concern not only because of its oversize production volume but also because of inadequate management policy in several countries. For example, e-waste is dumped from developed countries to developing ones under the name of free trade, charity or donation. For instance, export is legal in US and thus it exports 50 percent to 80 percent of e-waste collected (http://www.env.go.jp/recycle/3r/en/asia/02_03-4/11.pdf, accessed on March 20, 2011). US export its e-waste because it is a low-cost option for them to send the material for recycling in India (Silicon India, 2005). For instance, they send Cathode ray tube monitors to India as for them it is 10 times cheaper alternative.

Further, India is world's favorite dumping ground (Devangan, 2011). E-waste is exported from one country to another because of significant price difference in recycling and dismantling of e-waste in developing and developed nations, greater demand of electronic goods in developing countries (Skinner et al, 2010), weaker environmental regulations, low economic development (Wath et al, 2011), lenient occupational regulations (Li et al, 2006) and difficulty in classifying waste from product clearly (Maxianova, 2008) are the other reasons leading the export of e-waste. At times, when it seems difficult to export obsolete computers as such, bribe is offered to

make its flow easy. For instance, Inagaki (2008) mentioned that importers bribed the custom officials for changing the tag from obsolete computers to second-hand computers.

Rules and Regulations

Global Scenario

Management of e-waste is a mix of benefits and costs. Effective management of e-waste would help countries in many ways. But in the absence of proper management it may end up as a serious health and environmental hazard. Countries all around the globe have taken initiatives in framing rules and regulations for addressing the problem of e-waste management. Few examples are as under:

US

In US, The Resource Conservation and Recovery Act of 1976 (RCRA) and Environmental Protection Agency (EPA)'s CRT Rule controls e-waste and its export. But the RCRA Act of 1976 regulates only that e-waste which had been covered under the act's definition of hazardous waste. The problem is that most of the e-waste does not meet the criteria. Hence, e-waste is exported. In the same way, EPA's CRT rule does not deny the export of intact CRT's. Moreover, exporters exports e-waste under false labeling too (Skinner et al, 2010). Advance recycling fee (ARF) has been started by some states so that e-waste could be properly collected and handled. For instance, consumers in California have to pay from US $6 to US $10 depending on the electronic item (Gregory and Kirchain, 2007), producer responsibility bill get introduced by nearly 15 states but still the difficulty lies in the applicability of rules. The rules are confined to the boundaries of state only. As soon as the boundary changes, the scope of rules get modified as well, thereby bringing more complexity in the entire matter.

European Union (EU)

If we take the example of European Union (EU) then in EU the Council Regulation No. 259/93 (Waste Shipment Regulation) passed in 1993 and amended in 2007 governs the e-waste. According to WSR, export of e-waste from any EU member state is not allowed to non-OECD countries including India if it has been classified as hazardous. But the problem is that all e-waste components are not classified as hazardous and thus gets exported easily. In addition Maxianova (2008) explained that according to Waste Shipment Regulation wastes are classified

either in Green List or in Amber list. If the waste is classified in Green List then it needs simple data requirement without any administrative burden or restriction. But if it lies in the category of Amber list then strict restrictions are there in terms of notification procedure, contract between notifier and consignee along with financial guarantee. Moreover, author informed that most of the time the individual parts of discarded, disassembled electrical and electronic components gets easily exported as after disassembly it falls under the category of green list.

Philippines

In Philippines, there is an act known as Republic Act No. 6969 or the Toxic substances and Hazardous and Nuclear Wastes Control Act of 1990 which regulates materials with hazardous components. Beside this, in January 2001, Republic Act No.9003 or Ecological Solid Waste Management Act of 2000 got implemented. Still, as far as e-waste is concerned it lacks any clear specification (Peralta and Fontanos, 2006).

China

If we consider the example of China, then for household appliances like TV sets, air conditioners, washing machines and refrigerators, take-back legislation was enforced by China in Taiwan in the year 1988. In 1996, the Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by solid waste was issued and was later revised in December 2004.According to this law there should be reduction, proper recycling and disposal of solid waste in environmentally friendly manner and it is the responsibility of solid waste generators to prevent and reduce the pollution caused by waste by taking proper measures. In 2002, a law namely The Law of the People's Republic of China on the Promotion of Clean Production was also introduced which holds manufacturers responsible for recycling their products at the end of their useful life (Li et al, 2006).

An Indian Scenario

Like other parts of the world, initiative has been taken in India too. India has recently implemented E-waste (Management and Handling) Rules 2011 with an objective to channelize the e-waste generated in our country (http://envfor.nic.in/downloads/rules-and-

regulations/1035e_eng.pdf). These rules have been notified in May 2011 to give an adequate time to all the stakeholders so that they can plan the things and execute it accordingly. Rules got effective from May 01, 2012. The Indian rule has emphasized the concept of extended producer responsibility (EPR) and the Reduction in the use of Hazardous Substances (RoHS) in electrical and electronic equipment. The rules shall be applicable on every producer, dealer, collection centre, refurbisher, dismantler, recycler, auctioner, consumer and bulk consumers involved in the manufacture, processing, sale, purchase of electrical and electronic equipment or components as specified in the schedule. Though the countries across the world are adopting different kinds of principles so that e-waste could be properly managed, such as extended producer responsibility (EPR), advance recycling fees (ARF), individual producer responsibility (IPR) and polluter pays principle (PPP) but there relevancy in Indian context, still needs to be addressed.

There are several challenges to confront while addressing issues of e-waste management. For example, heavy cost associated with its recycling and disposal. It is hard to clearly differentiate product from second hand good or e-waste. Similarly, it is not easy to distinguish second hand electronics and e-waste. Under the Harmonized Commodity Description and Coding System (HS) many national systems tracking trade do not have specific codes which differentiate new and second hand goods (Terazono et al, 2006). Different countries are including different products while defining and estimating e-waste. Hence, it is difficult to compare the estimation of e-waste generation too. Moreover, there is a lack of reliable data on generation of e-waste in many countries. Reliability of data is also problematic as each country is using its own method for estimating e-waste generation. Wath et al (2011) stated that there are socioeconomic, infrastructural and legal issues which will create an obstacle for managing e-waste in India but at the same time managing e-waste in India will give rise to several opportunities as well.

RATIONALE

Literature indicates that the quantum of e-waste getting generated is enormous. With rapid growth of electronic industry the magnitude of e-waste growing is certain to rise exponentially. It therefore needs an effective management system. E-waste is relatively a newer waste stream in comparison to other wastes such as, municipal solid waste, bio-medical waste for which proper management system is yet to evolve. Failure of prior rules to effectively manage hazardous

wastes (for instance, Batteries Management and Handling Rules 2001) warrants a more careful investigation in managing such wastes. Non inclusion of informal sector and inadequate availability of e-waste for recycling due to failed collection mechanism also prompts for undertaking the present research. With increasing concerns for protecting the environment for future generations it is necessary to pay attention on the scientific recycling of e-waste. Recycling of e-waste is one of the ways which would help in managing e-waste properly. Proper recycling of it can act as a source of raw materials for many associated industries. In the absence of which, it may lead to wastage of resources.

Efficient recycling of e-waste can create positive impact on economy, society and on environment too. If e-waste gets managed effectively then it may help in opening employment avenues to many people there by generating revenue. This would help in improving their standard of living as well. Review of literature also indicates that more than 90 percent of recycling of e-waste is under the control of informal sector which uses rudimentary methods for processing, creating a negative impact on health and environment. It makes it necessary to understand the ways by which the unorganized sector can be included into formal recycling sector. All this, indicates that recycling and recyclers of e-waste are important aspects of efficient e-waste management. Recyclers of e-waste are among one of the significant stakeholder to be studied. Thus, the research is undertaken so as to understand the problems of e-waste recyclers in India. Understanding the perception of recyclers towards e-waste management and the challenges faced by them would throw light on the areas need to be worked upon so that e-waste could be managed effectively. There is dearth of studies focusing on management of e-waste from the perspective of recyclers as well in Indian context. Hence, it makes crucial to understand the constituents of e-waste management in India from the perspective of e-waste recyclers.

OBJECTIVES

The study is undertaken with the following objectives:

1. To assess the perception of recyclers towards e-waste management.
2. To identify the issues and challenges in e-waste management.
3. To suggest the strategies for improving e-waste management practices.

METHOD

Study: The study is exploratory in nature. It is aimed at identifying the constituent of e-waste management in India. Perception of e-waste recyclers will be studied to identify the enablers and deterrents of e-waste management.

Design: The procedure that will be followed will consist of following steps:

Step 1: Relevant literature will be reviewed to understand the e-waste management system in India and to identify the different stakeholders.

Step 2: Recyclers from different geographical regions in India will be selected and contacted for understanding their perception towards e-waste management.

Step 3: Case studies will be developed on the basis of interactions with these recyclers.

Step 4: Case studies developed will be analyzed and discussed in the light of available literature.

Step 5: Recommendations will be made on the basis of the case analyses for improving the effectiveness of e-waste management.

Sample:

1. E-waste recyclers operating in India will constitute the universe of population for the study.
2. A sample of 10 recyclers will be selected using purposive sampling method to understand their perceptions towards e-waste management.

Tool for Data Collection: Case method will be used to collect the necessary data for the study. Select recyclers will be approached and requested to participate in the study. Cases will be developed for each of the selected recycler after obtaining their consent for the same.

Tools for Data Analysis: Case studies developed will be analyzed using appropriate methods and tools to identify the issues involved and perceptions of recyclers towards e-waste management.

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CHAPTER OUTLINE

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